

16th IAA SYMPOSIUM ON SPACE DEBRIS (A6)  
Policy, Legal, Institutional and Economic Aspects of Space Debris Detection, Mitigation and Removal  
(Joint Session with IAF Space Security Committee) (8)

Author: Mr. Quentin Verspieren  
University of Tokyo, Japan, verspieren@space.t.u-tokyo.ac.jp

Mr. Goutham Karthikeyan  
Institute of Space and Astronautical Science, Japan Aerospace Exploration Agency, Japan,  
Goutham@ac.jaxa.jp  
Dr. Yuri Takaya-Umehara  
The University of TOKYO, Graduate school, Japan, yuritakaya@gmail.com

SUSTAINABLE OPERATION OF LARGE CONSTELLATIONS OF SATELLITES IN LEO: GOING  
BEYOND EXISTING DEBRIS MITIGATION RECOMMENDATIONS

**Abstract**

While actively contributing to the socio-economic development of remote areas of the planet by connecting them to the rest of the world, the multiple projects of large constellations with thousands of satellites promoted by corporations such as Boeing, OneWeb, SpaceX or Samsung pose a great threat to the long-term sustainability of space environment in Low Earth Orbit (LEO). With around 1200 active satellites currently in orbit around the Earth, the deployment of these constellations would result in an unprecedented congestion of outer space, potentially worsening the debris issue in the future. The U.S. Federal Aviation Administration's Office of Commercial Space Transportation (FAA AST) estimated the number of new payloads launched at around 3000 within the next decade (2018-2027) in its *2018 Annual Compendium of Commercial Space Transportation*, mostly driven by OneWeb's 700-satellite constellation. Organisations from academia, government or industry have been closely studying these projects and providing recommendations for limiting their impacts. It therefore raises the following interrogations: (1) what are the current guidelines for debris mitigation in the case of large constellations, (2) what are their limitations (technically and politically), and (3) what innovative policies and practices can be proposed to overcome these limitations?

To answer these questions, this paper presents an up-to-date critical review of recommendations made by international organizations and consultative groups, directed at future operators of large constellations in LEO, as well as policy initiatives at various level to ensure the long-term sustainability of space environment. Then it investigates new approaches for the mitigation of debris generated by large constellations, from technical and political perspectives such as liability issues of state and non-state players providing active post-mission disposal services, promoting the involvement of constellation operators themselves in enhancing Space Situation Awareness, or incentivising adherence to good debris mitigation practices through favourable frequency allocation.